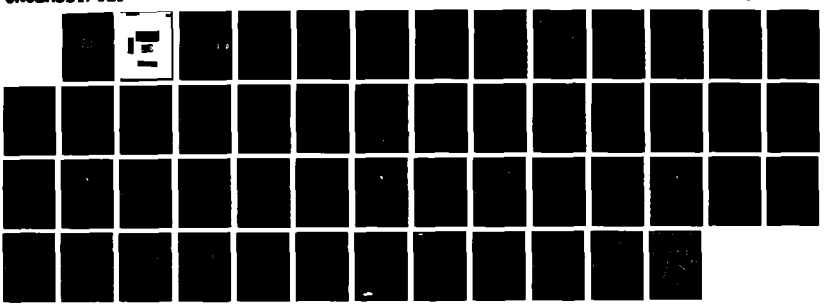
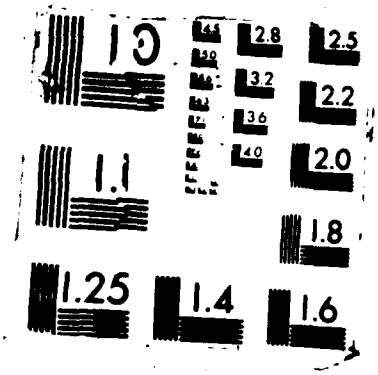
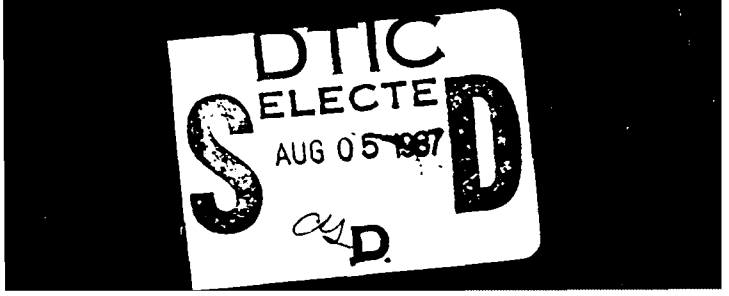
AD-A183 771 MS-116A HIGH VOLTAGE PROTECTION UNIT(U) MILLER (R A) INDUSTRIES INC GRAND HAVEN MI T H SEEKMAN 10 JUL 87 DAAB07-86-C-A010 1/1

UNCLASSIFIED F/G 10/2 NL




1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0

MS-116A High Voltage Protection Unit
Final Status Report
Contract No: DAAD07-86-D-N010
DRIN 0002 Sequence A002
IAW DI-S-3057



(10)

MS-116A HIGH VOLTAGE PROTECTION UNIT
FINAL STATUS REPORT

PREPARED BY:
THOMAS H. SEEKMAN
R.A. MILLER INDUSTRIES, INC.
14500 168TH AVENUE
GRAND HAVEN, MI 49417

JULY 10, 1987

CONTRACT NO: DAAB07-86-C-A010
CLIN 0002 SEQUENCE A002
IAW DI-S-4057

PREPARED FOR:
THE UNITED STATES ARMY
COMMUNICATIONS ELECTRONICS COMMAND
FORT MONMOUTH, NJ 07703-5000

87

OVERVIEW

This is the final status report for the development contract DAAB07-86-C-A010. The report is split into two (2) parts, Part 1 is on the development and preliminary testing and Part 2 is on the production and final testing. This was doe because, even though both had testing involved, the approach is totally different. The mentality of development and that of production are opposite in every way and each warrants separate reporting. It is intended that each part report everything that was done in a concise but thorough way with conclusions drawn from what ha been observed.

LIST OF FIGURES

PART 1: DEVELOPMENT AND PRELIMINARY TESTING

1. INTRODUCTION

This status report covers everything that R.A. Miller Industries has accomplished in the area of development and testing of MS-116A High Voltage Protection Unit (HVPU). Included in this report are the status of Mechanical/Electrical Design, Prototype Production, Testing (both Preliminary Design and Finished Prototype), and System Safety Analysis. It is the intention of this reporter to provide a succinct synopsis on each of the afore mentioned scopes. The synopsis will cover all aspects since the commencement of development until the present day.

2. OBJECTIVES

2.1 MECHANICAL/ELECTRICAL DESIGN

The Mechanical/Electrical design of the HVPU was conceived after consideration of the operating conditions experienced and the function to be accomplished. Many possible designs were considered, weighing the disadvantages and advantages of each to achieve the optimum result. Preliminary testing played a vital role in the Mechanical/Electrical Design process. The HVPU was developed by close comparative testing with a conventional MS-116A Unit so that the basic characteristics were as similar as possible. The HVPU Mechanical/Electrical Design has been accomplished and a detailed set of drawings to be used for prototype manufacture has been produced.

2.2 TESTING

2.2.1 PRELIMINARY TESTING FOR MECHANICAL/ELECTRICAL DESIGN

Much preliminary testing was required and accomplished in the design phase to achieve the optimum result. In each development test, the prototype HVPU and a conventional MS-116A Unit were subjected to the same conditions and comparisons drawn.

2.2.1.1 FLEXURAL STRENGTH

To compare flexural strength (which is the most important Mechanical design aspect), a fixture which places the Test Specimen parallel to the ground is employed. A dynamometer/force application set-up was used to apply and measure force applied to the tip end (as opposed to the male-threaded end, which is screwed into the fixture) of the Test Specimen at a right angle

to the specimen's axial direction (Perpendicular to the ground). The conventional MS-116A unit was testing first and the force required for failure was noted and used as a target for design. Many plug materials were tested and compared with many fracturing before reaching the design threshold. The chosen plug material, an 80% glass fiber/epoxy resin pultrusion rod exceeded the design threshold before the tube yielded, effectively providing more flexural strength than a conventional MS-116A. See figures 1 and 4 and test reports.

2.2.1.2 HIGH VOLTAGE

To check for deleterious effects on the High Voltage Coaxial Capacitor (HVCC) components, the prototypical design was subjected to a 30 KVDC test (which is a greater voltage than the anticipated maximum of 25 KVDC.) The components showed no damage after one (1) minute of continuous application. The test was repeated after subjection to the sag test (2.2.1.3) and there was no difference. See figure 2 and test reports.

2.2.1.3 ASSEMBLY DISPLACEMENT (SAG)

The conventional fifteen (15) foot HF Military Whip Antenna (3 MS-116A, 1 MS-117A, and 1 MS-118A Units) was fixtured in a horizontal position an displacement measurements at different places along the assemblys length taken from an assembly using an MS-116A HVPU. The test yielded that the HVPU is more rigid than the standard unit. See figure 3 and test report.

2.2.1.4 HVCC CAPACITANCE

The effect of installing a capacitor in the whip had to be determined by analyzing the AN/GRC-106 Radio Set. Since an AN/GRC-106 Radio was not supplied to us, assumptions had to be made. Since the AT-1095A/VRC Modified Upper Whip Section that R.A. Miller is developing has a capacitance value of around 130pf, it was used as a goal. Several lengths and dielectric materials for the capacitor were tried until the target value was achieved.

2.2.1.5 BALLISTIC SHOCK

Preliminary testing of the MS-116A HVPU in the whip assembly subjecting it to ballistic shock was deemed necessary before producing the finished prototypes as assurance that the assemblys mechanical integrity was not compromised by the HVPU. An antenna assembly containing an HVPU was subjected to and passed ballistic shock testing.

2.2.2 PROTOTYPE ENVIRONMENTAL TESTING

Once the one hundred (100) prototype units have been produced they will be divided into five (5) lots of twenty (20) for environmental testing. The environmental tests to be performed are a specified in R.A. Miller Industries' Design Plan which was submitted and accepted in August 1986. A test plan has been written and submitted for acceptance which details the individual test procedures. The division into 5 lots of 20 units was done for time considerations, so not all of the prototypes will be subjected to all the tests.

2.3 SYSTEM SAFETY ANALYSIS

A System Safety Assessment Report was written and submitted in December 1986. It was the report's conclusion that there were no significant factors in the device's design which would have any impact on safety (i.e. no toxic/hazardous materials are used in the HVPU's construction).

3.0 CONCLUSIONS

It is the conclusion of R.A. Miller Industries that the preliminary design work has been successfully completed. The manufacture of the prototypes will commence immediately with environmental testing to follow upon prototype production completion.

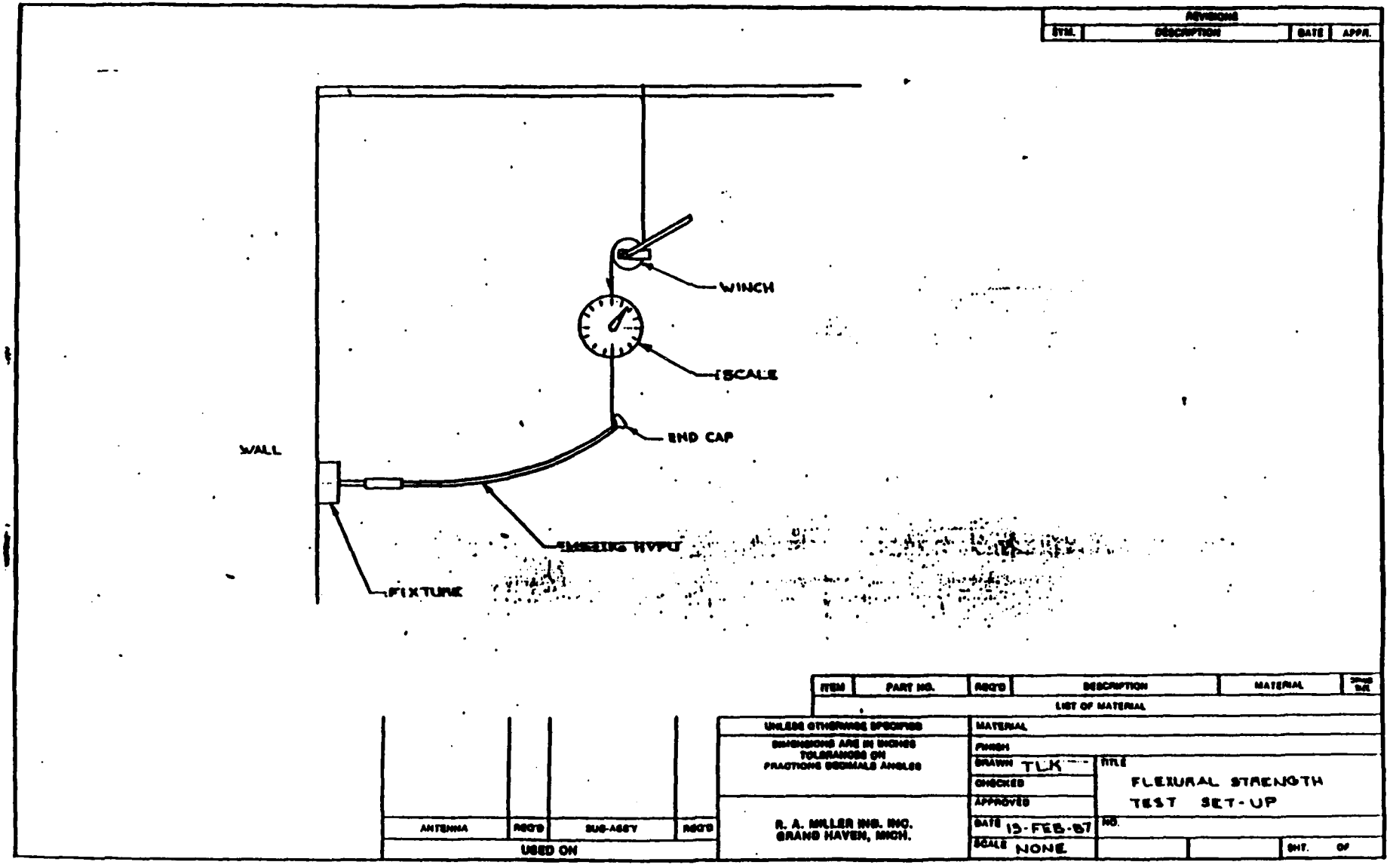

REVISIONS
SYM. DESCRIPTION DATE APPR.
WINCH
SCALE
END CAP
WALL
FIXTURE
ITEM PART NO. REQ'D DESCRIPTION MATERIAL
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS DECIMALS ANGLES
MATERIAL
FINISH
DRAWN TLK
CHECKED
APPROVED
DATE 15-FEB-67
SCALE NONE
TITLE
FLEXURAL STRENGTH
TEST SET-UP
NO.
SHT. OF
R. A. MILLER IND. INC.
GRAND HAVEN, MICH.
ANTENNA REQ'D SUB-ASSY REQ'D
USED ON

Figure 1

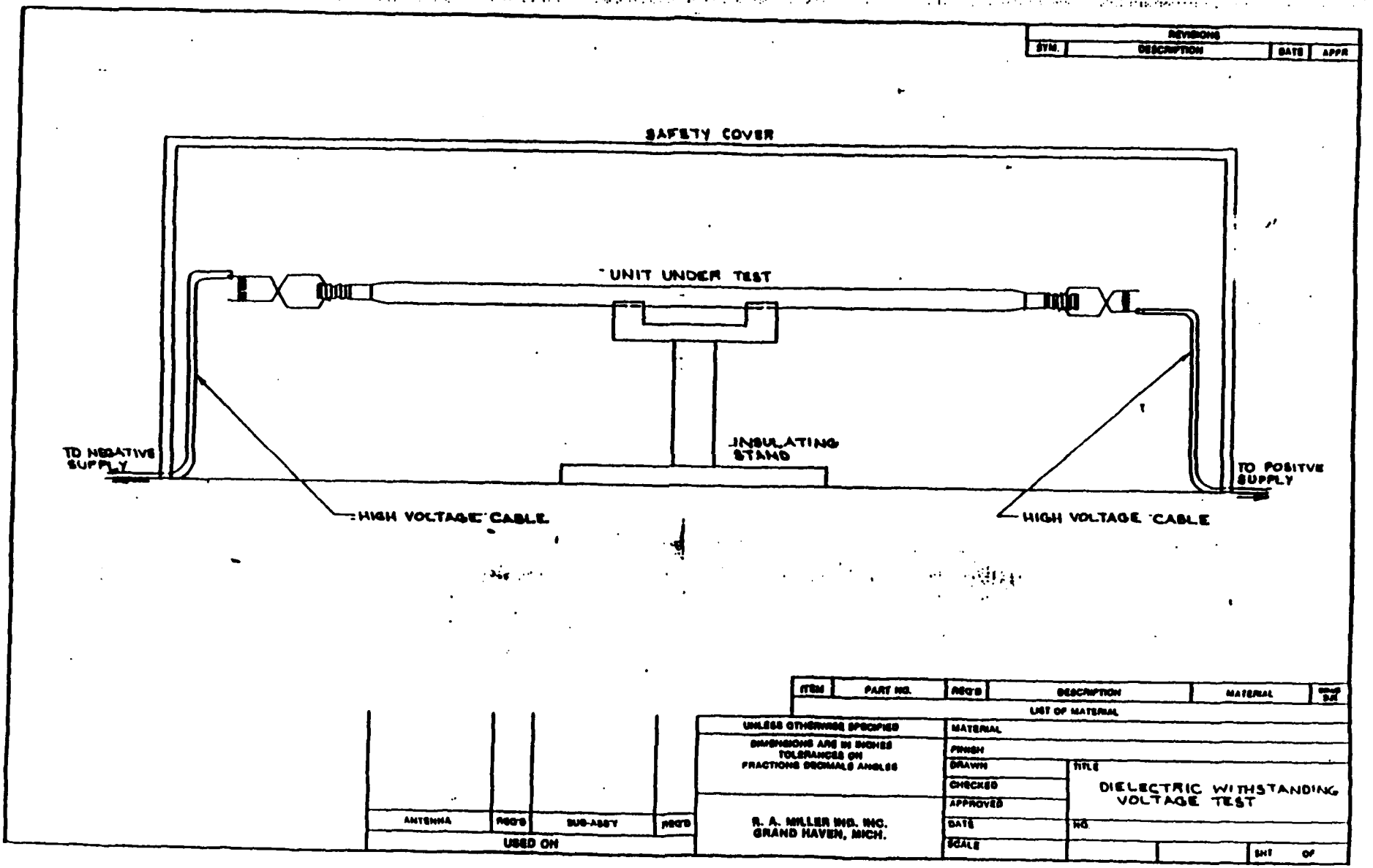

REVISIONS
SYM.
DESCRIPTION
DATE
APPR
SAFETY COVER
UNIT UNDER TEST
INSULATING STAND
TO NEGATIVE SUPPLY
TO POSITVE SUPPLY
HIGH VOLTAGE CABLE
HIGH VOLTAGE CABLE
ITEM
PART NO.
REQ'D
DESCRIPTION
MATERIAL
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS DECIMALS ANGLES
MATERIAL
FINISH
DRAWN
CHECKED
APPROVED
DATE
SCALE
TITLE
DIELECTRIC WITHSTANDING VOLTAGE TEST
R. A. MILLER IND. INC.
GRAND HAVEN, MICH.
NO.
SHT
OF
ANTENNA
REQ'D
SUB-ASSY
REQ'D
USED ON

Figure 2

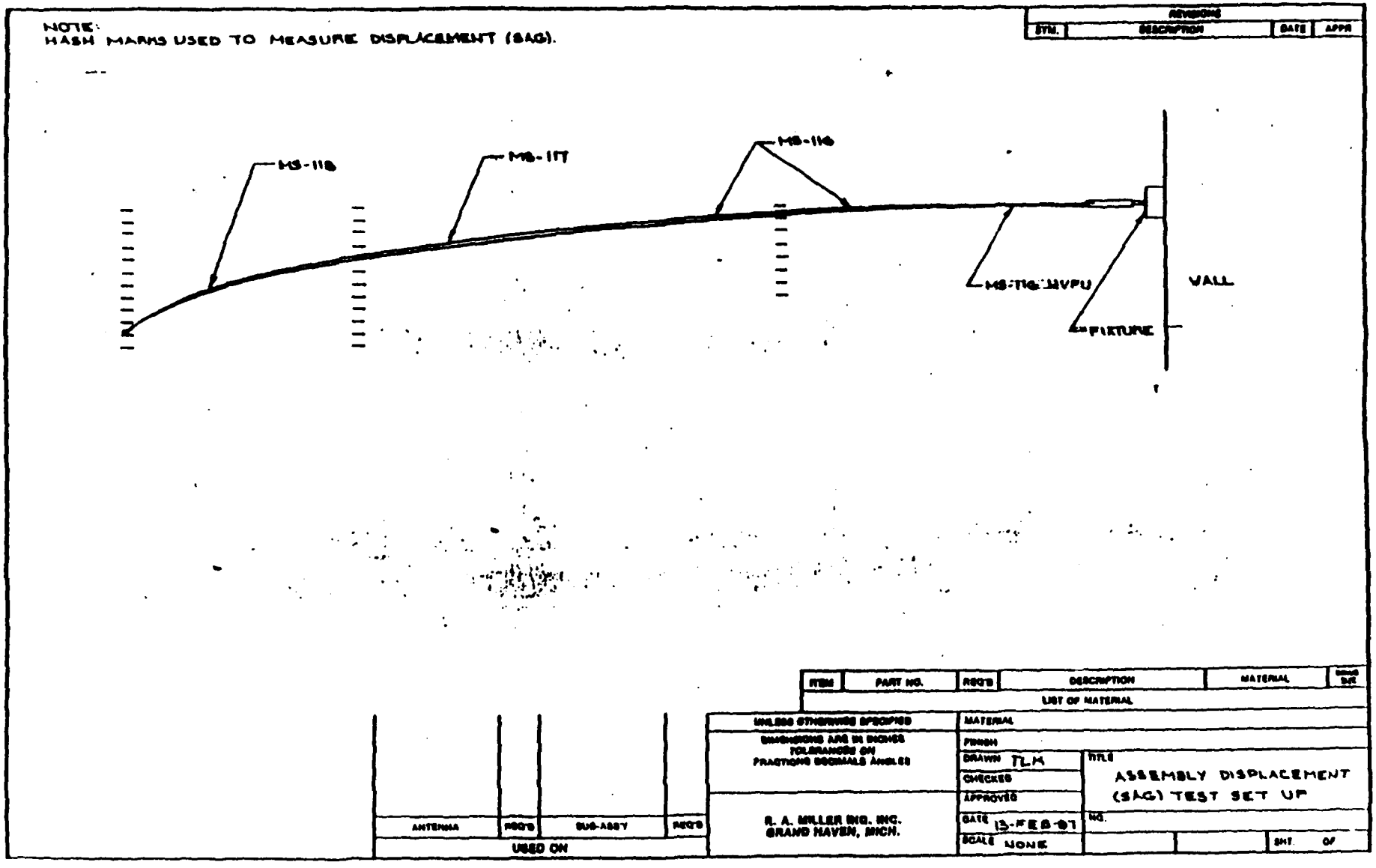

NOTE:
HASH MARKS USED TO MEASURE DISPLACEMENT (SAG).
MS-115
MS-117
MS-116
MS-116 MVPU
WALL
FIXTURE
REVISIONS
SYM.
DESCRIPTION
DATE
APPR
ITEM
PART NO.
REQ'D
DESCRIPTION
MATERIAL
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS DECIMALS ANGLES
MATERIAL
FINISH
DRAWN TLH
CHECKED
APPROVED
DATE 15-FEB-91
SCALE NONE
TITLE
ASSEMBLY DISPLACEMENT
(SAG) TEST SET UP
NO.
SHT. OF
R. A. MILLER IND. INC.
GRAND HAVEN, MICH.
ANTENNA
REQ'D
SUB-ASSY
REQ'D
USED ON

Figure 3

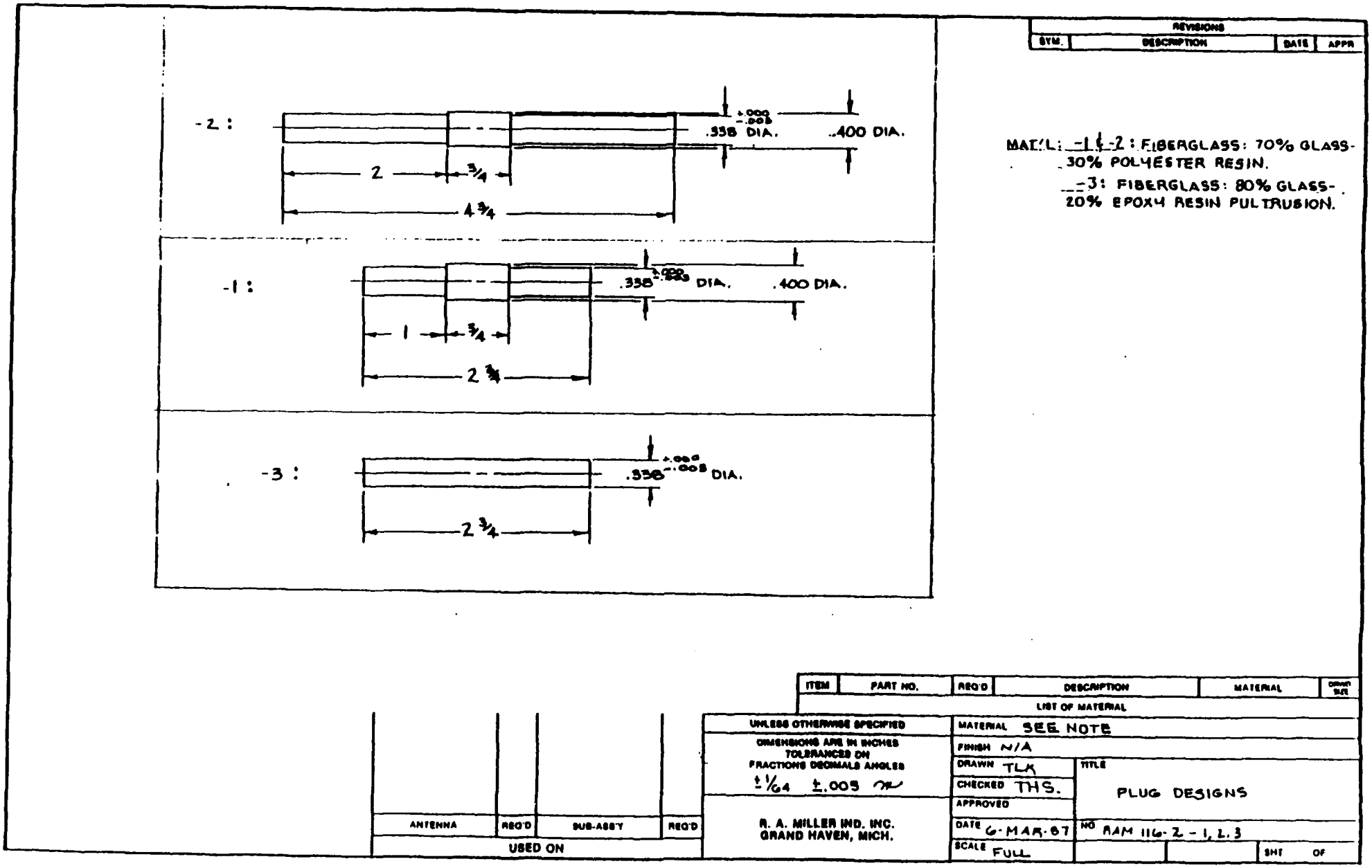

REVISIONS
SYM. DESCRIPTION DATE APPR
-2 :
.358 DIA.
.400 DIA.
2
3/4
4 3/4
-1 :
.358 DIA.
.400 DIA.
1
3/4
2 3/4
-3 :
.358 DIA.
2 3/4
MAT'L: -1 & -2 : FIBERGLASS: 70% GLASS- 30% POLYESTER RESIN.
-3: FIBERGLASS: 80% GLASS- 20% EPOXY RESIN PULTRUSION.
ITEM PART NO. REQ'D DESCRIPTION MATERIAL
LIST OF MATERIAL
UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS DECIMALS ANGLES
±1/64 ±.005
MATERIAL SEE NOTE
FINISH N/A
DRAWN TLK
CHECKED THS.
APPROVED
DATE 6-MAR-87
SCALE FULL
TITLE
PLUG DESIGNS
NO RAM 116-2-1, 2, 3
SHT OF
R. A. MILLER IND. INC.
GRAND HAVEN, MICH.
ANTENNA REQ'D SUB-ASSY REQ'D
USED ON

Figure 4

MS-116A HVPU Flexural
Test Report

Contract: DAAB07-86-C-A010
Test Date: 25-JUL4-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 966 lb.

Remarks: Failure in the standard unit was determined when tube buckling occurred. The HVPU also failed when tube buckled and there was no visible damage in the plug area. The plug area was covered with a fiberglass cloth wrap which adds to the profile of the unit. The plug material used was a 70% glass, 30% polyester resin which is also used for AT-1095 whip cores. A test will be performed on a test item without the fiberglass cloth wrap to determine if it is required.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN-MECH. ENG. 25-JUL-86

Ben Emens ELECT ENG 25 JUL 86

MS-116A HVPU Flexural
Test Report

Contract: DAAB07-86-C-A010
Test Date: 29-JULY-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 704 lb.

Remarks: The test item failed at a much lower force value than in the first test. Failure occurred with a brittle fracture of the core material. The fiberglass cloth wrap is necessary for flexural strength. Another test item will be manufactured and tested to verify that the design is satisfactory.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN-MECH. ENG. 29-JUL-86

Bill Emerson ELECT ENG 29 JUL 86

MS-116A HVPU Flexural
Test Report

Contract: DAAB07-86-C-A010
Test Date: 14-OCTOBER-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 860 lb.

Remarks: The HVPU failed via brittle fracture of the plug material and the fiberglass cloth wrap. This failure was totally unanticipated because of the initial test's success. Manufacturing techniques will be scrutinized as the probable cause of the premature failure. Alternate plug materials and shapes will be researched also.

Test Witnessed By:

Thomas H Seekman THOMAS SEEKMAN-MECH. ENG. 14-OCT-

Ron Pinnings ELECT ENG 14 OCT 96

MS-116A HVPU Flexural
Test Report

Contract: DAAB07-86-C-A010
Test Date: 21-NOVEMBER-1986

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 752 lb.

Remarks: The plug's overall length was increased by two (2) inches for added adhesion but brittle fracture occurred. The added moment arms caused by the increased length caused the fracture. The plug material seems to be weaker when the step is machined in it also. A solid plug design will be implement and a stronger material will be researched and procured.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN-MECH. ENG. 21-NOV-8

B... Simmons ELECT ENG 21 NOV 8...

MS-116A HVPU Flexural
Test Report

Contract: DAAB07-86-C-A010
Test Date: 6-FEBRUARY-1987

Standard MS-116A

Force Req'd for failure: 966 lb.

HVPU

Force Req'd for Failure: 1024 lb.

Remarks: A solid plug of 80% glass, 20% epoxy resin was used. The diameter of the plug was .025" undersize and didn't have the fiberglass cloth wrap. Failure occurred via tube buckling. It was determined that the 80% glass, 20% epoxy resin material is the best material available. The unprotected material showed only a small amount of crazing and provided more flexural strength than the solid steel tube. The proper diameter and an overwrap will be used.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN - MECH. ENG. 6-FEB-87

[illegible] ELECT ENG 6 FEB 87

MS-116A HVPU

High Voltage Test Report

Contract: DAAB07-86-C-A010

Test Date: 26-June-1986

Test Voltage (KV)	Current Leakage (μA)
25	1
30	1.5

Remarks: The test item was tested at 25KV and 30KV (5KV more than required for added assurance) and showed no detrimental effects with the current leakage values recorded. There is no evidence of arcing, neither auditory or visual and no burn marks were found on the item.

Test Witnessed By:

Ben Emmons ELECT ENG 26 JUN 86

MS-116A HVPU

High Voltage Test Report

Contract: DAAB07-86-C-A010

Test Date: 5-March-1987

Test Voltage (KV)	Current Leakage (μA)
25	1
30	1.5

Remarks: The test item was high voltage tested after being subjected to to the assembly displacement (SAG) test to check if the stresses encountered induced any detrimental effects to the capacitive capability of the HVPU. It was found that there was negligible effect in the measurements.

Test Witnessed By:

Thomas H. Seekman THOMAS SEEKMAN- MECH. ENG. 5-MAR-8

Paul Miller Paul Miller - Engineering Manager 5-MAR-

Antenna MS-116A Assembly
Displacement (SAG) Test

Contract: DAAB07-86-C-A010
Test Dates: 3-March-1987 to 5-March-1987

Standard Unit

	Time	Wall Mount	1st Joint	2nd Joint	3rd Joint	4th Joint	Tip
3-MAR	8:00 AM	107	103½	95	84	72	60
	9:00 AM	107	103½	94 3/4	83 3/4	72	59 3/4
	10:00 AM	107	103½	94 3/4	83 3/4	72	59 3/4
	11:00 AM	107	103½	94 3/4	83 3/4	72	59 3/4
	1:00 PM	107	103½	94 3/4	83 3/4	72	59 1/2
	3:00 PM	107	103½	94 3/4	83 3/4	72	59 1/2
4-MAR	8:00 AM	107	103½	94 3/4	83 3/4	72	59 1/2

HVPU Unit

	Time	Wall Mount	1st Joint	2nd Joint	3rd Joint	4th Joint	Tip
4-MAR	8:00 AM	107	103½	95 3/8	84 3/4	74	62 3/8
	9:00 AM	107	103½	95 1/4	84 3/4	73 1/2	62
	10:00 AM	107	103½	95 1/4	84 3/4	73 3/8	61 3/4
	11:00 AM	107	103½	95	84 3/8	73 1/4	61 5/8
	1:00 PM	107	103½	95	84 1/4	73 1/8	61 3/8
	3:00 PM	107	103½	95	84 1/4	73 1/8	61 3/8
5-MAR	8:00 AM	107	103 3/8	94 7/8	84 1/8	72 7/8	61 1/8

*All measurements in inches from floor

Test Witnessed By:

Paul Miller 3/5/87
Paul Miller Engineering Manager

Thomas H. Seekman 5-MARCH-1987
Tom Seekman Mechanical Engineer

James C Clark 3/5/87
Jim Clark Test Engineer

Mary Ramirez QAR 05 March 1987
Mary Ramirez QAR

PART 2: PRODUCTION AND TESTING

1 INTRODUCTION

This status report covers the aspects of R.A. Miller Industries' production and subsequent production testing of the MS-116A High Voltage Protection Unit (HVPU). Included in this report are the status of Prototype Production and Testing, Final Test Report Excerpts, and the final conclusions of the design team. It is intended that this report provide a succinct synopsis of all aspects since the commencement of production until its completion.

2 OBJECTIVES

2.1 PRODUCTION OF HVPU

Upon completion of the design/development phase, the one hundred (100) prototype unit production phase commenced. In the production phase, manufacturing techniques had to be developed for use on the HVPU's. While these techniques produced very satisfactory results, they are by no means 100% perfect nor would they be expected to be. Fine-tuning of these techniques would be expected on any future production. These fine-tunements would not adversely affect the performance of the HVPU since the basics of techniques will remain unchanged.

2.2 TESTING

Upon completion of the production of the HVPU's, the First Article Product Assurance Testing commenced as was set forth in our Test Plan (submitted 26-February-1987) with five (5) lots of twenty (20) antennae. The HVPU's were subjected to the following sequence of tests: Capacitance, Visual/Mechanical, High Voltage Stress, Voltage Standing Wave Ratio, High temperature, Low Temperature, Ballistic Shock, Humidity, Vibration, and Impedance (order of tests). The HVPU's passed all the tests without any failures (See Figure 1-Final Test Report Excerpts).

A special testing note: This is to explain the rather large discrepancy between the leakage current values measured in the development preliminary testing and the ones measured during prototype production testing (1mA vs. 4mA). During the development testing the HVPU was fixtured differently than during the production testing and it was discovered that positioning in the fixture affected the leakage current because the fixture had leakage through it also. Another reason for the

discrepancy is the fact that during development testing the humidity level was much lower than it was during the production testing. High humidity causes more leakage to occur. The values recorded for production testing were the worst values obtainable. The HVPU's were moved in the fixture until the worst value (highest value for leakage current) was found.

3.0 CONCLUSIONS

It is the conclusion of R.A. Miller Industries that the production prototypes will offer the desired high voltage protection without compromising the mechanical integrity of the whip. It has been shown that the flexural properties have been actually improved with the inclusion of the capacitance unit. The flexural strength of the HVPU was increased over that of the standard MS-116 and the assembly is more rigid because of the HVPU's presence. This will enhance the stability of the assembly by eliminating harmonic frequencies when it is vibrated during operation.

FIGURE 1

1.0 INTRODUCTION

A high voltage coaxial capaictor is fitted within the MS-116 lowest section. The purpose of the coaxial capacitor is to protect military vehicle personnel from high voltage shock if the vehicle's whip antenna contacts an overhead powerline (typically 15-20 KVRMS).

After final design of the MS-116 HVPU is complete, one hundred units shall be built. They will be spilt into five lots of 20 so that different tests may be ongoing at the same time to speed testing. The units will be stepped through the following tests according to 2.0 Test Requirements.

1.1 MANUFACTURER

R.A. Miller Industries, Inc.
P.O. Box 858
14500 168th Avenue
Grand Haven, MI 49417

1.2 DRAWING SPECIFICATION OF EXHIBIT

The 100 116 HVPU's will be IAW CENCOMS technical requirements COM-TR-033-01, dated 15 APR 85.

1.3 QUANTITY OF ITEMS TO BE TESTED

(100) One Hundred

1.4 SECURITY OF ITEMS TO BE TESTED

Unclassified

1.5 DATE BY WHICH TESTS ARE TO BE COMPLETED

May 30, 1987

1.6 DISPOSITION OF SPECIMENS

To be shipped to:

Consolidated Property Office
Building 117
Fort Monmouth, NJ 07703

Mark for:

AMSEL-RD-COM-TR-I
Building 39, Evans Area
Contract DAA807-86-C-A010

2.0 Test Requirements

Test	SEC.	MS-116 HVPU S/N / Order of Tests 1-20	21-40	41-60	61-80	81-100	*	**	***	****
Capacitance	6-1	1	1	1	1	1	X			1/2
Visual Mechanical	6-2	2	2	2	2	2				1/2
High Voltage Stress	6-3	3	3	3	3	3			X	1/2
VSWR	6-4	4	4	4	4	4		X	X	1/2
High Temperature	6-5		5		5					1 1/2
Low Temperature	6-6	5		5						1 1/2
Ballistic Shock	6-7					5		X		7
Humidity	6-8		6							14
Vibration	6-9				6			X		3
Impedance	6-10	6		6				X		2

NOTE: 1. * = Test before unit complete

2. ** = Uses complete 15 foot whip assembly

3. *** = This test repeated as post testing

4. **** = Test duration per lot (20 unit) in days (not including post testing)

(22)

3.0 STANDARD TEST CONDITIONS

Unless otherwise specified, the following standard test conditions shall prevail during testing:

CONDITION	VALUE/TOLERANCE
Temperature	Prevailing ambient
Altitude	Ground level

4.0 LIST OF TEST EQUIPMENT

EQUIPMENT NAME	REF
Capacitance Meter Sencore LC53	6.2
Model 05460A D.C. Hypot - Assoc. Research Inc.	6.3
Wiltron Model 640 Network Analyzer	6.4
Hewlit Packard Model 4191A RF Impedance Analyzer	6.10

Equivalent equipments may be subsituted.

5.0 LIST OF ABBREVIATIONS

1. HVPU - High Voltage Protection Unit
2. S/N - Serial Number
3. pF - Pico Farads
4. mA - Micro amperes
5. R.F. - Radio Frequency
6. Cu - Copper
7. R. Loss - Return Loss
8. VSWR - Voltage Standing Wave Ratio
9. F - Farenheit
10. C - Centigrade
11. Fig. - Figure
12. +ve - Positive
13. MHz - MegaHertz
14. Sec. - Section
15. Q.C. - Quality Control
16. Rep. - Representative
17. Gov't- Government

c. CAPACITANCE TEST DATA SHEET

MS-116 HVPU

DATE: 6-4-87 TESTED BY: Jim Clark

S/N: A WITNESS: Anthony Sherriff N/A

QC REP RAM 2 GOV'T REP

S/N	CAPACITANCE in pF	S/N	CAPACITANCE in pF
1	138	11	140
2	142	12	142
3	139	13	142
4	141	14	142
5	140	15	143
6	142	16	140
7	141	17	140
8	139	18	141
9	142	19	143
10	142	20	143

VISUAL AND MECHANICAL TEST DATA SHEET

MS-116 HVPU

DATE: 6-12-87 INSPECTED BY: Amy Hudd

S/N: A WITNESS BY: Amy Hudd QC REP Amy Hudd RAM 4 GOV'T REP N/A

CHARACTERISTIC		ACTUAL MEASUREMENT RESULTS	PASS (X)	FAIL (X)
Overall Length	39 1/2 ± 1/4	See Attached Sheet	X	
Upper Threads			X	
* Upper Diameter				
Upper Taper			X	
* Lower Threads				
* Lower Taper				
Surface Finish			X	
Cleanliness			X	
Workmanship			X	

Comments: *Verified though Interchabilty

OVERALL LENGTH

MS-116 HVPU

DATE: 6-12-87

INSPECTED BY: Amy Hudd

WITNESS BY: Amy Hudd

Q.C. REP GOVT. REP

RAM 4

REQUIREMENT: 39 1/2 ± 1/4

S/N	ACTUAL	PASS	FAIL
1	39 17/32	X	
2	39 17/32	X	
3	39 17/32	X	
4	39 9/16	X	
5	39 17/32	X	
6	39 17/32	X	
7	39 1/2	X	
8	39 9/16	X	
9	39 17/32	X	
10	39 9/16	X	
11	39 17/32	X	
12	39 17/32	X	
13	39 17/32	X	
14	39 9/16	X	
15	39 17/32	X	
16	39 19/32	X	
17	39 17/32	X	
18	39 17/32	X	
19	39 9/16	X	
20	39 17/32	X	

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-12-87 TESTED Jim Clark

S/N: 8 WITNESS Connie Lyles N/A

QC REP Connie Lyles GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
21	3.2 kV A	
22	3.9 kV A	
23	4.0 kV A	
24	3.7 kV A	
25	3.5 kV A	
26	4.1 kV A	
27	3.7 kV A	
28	3.8 kV A	
29	3.7 kV A	
30	3.4 kV A	
31	2.9 kV A	
32	3.0 kV A	
33	4.0 kV A	
34	3.0 kV A	
35	3.6 kV A	
36	2.5 kV A	

Comments: _____

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-12-87 TESTED BY: Jim Clark

S/N: B WITNESS: Connie Lyles N/A
QC REP GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
37	3.7 kV A	
38	3.8 kV A	
39	2.8 kV A	
40	2.6 kV A	

Comments:

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip Sandy D'Oyly

DATE: 6-12-87 TESTED BY Sandy D'Oyly

Lot B

WITNESS Connie Lyles N/A

QC REP GOV'T REP

S/N	Frequency of resonance in MHz	R Loss	VSWR
21	19.5	26	1.11
22	19.6	26	1.11
23	19.6	24	1.13
24	19.6	25	1.12
25	19.6	23	1.15
26	19.7	25	1.12
27	19.5	27	1.09
28	19.6	28	1.08
29	19.5	27	1.09
30	19.5	28	1.08
31	19.5	28	1.08
32	19.6	26	1.11
33	19.4	27	1.09
34	19.4	28	1.08
35	19.6	27	1.09
36	19.6	26	1.11
37	19.5	27	1.09
38	19.5	27	1.09
39	19.4	28	1.08
40	19.5	28	1.08
Standard MS 116	17.2	22	1.17

PRODUCT TESTING LABORATORY TEST LOG

JOB NO. M0019 CUSTOMER _____ P.O. NO. _____

TEST ENGINEER ~~Tim Clark~~ Jim Clark TEST TECH. _____ GSI/WITNESS _____

PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) MS 116 HIPD SN 21-41/61-80

TEST DESCRIPTION (Vib., Shock, Etc.) HIgh temperature

TEST PROC. R.A. Miller

DATE	TIME	EVENT DESCRIPTION
6-16-87	11:15	Placed test items into chamber
6-16-87	11:50	Allowed chamber temperature to stabilize +71^{0}C (+160^{0}F)
6-17-87	11:50	Returned chamber to ambient temperature +70^0 F
6-17-87	13:50	Preformed post test

113(9-78)NS

PAGE ____ OF ____

POST HIGH TEMP
PRE HIMIDITY

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip Jan Clar

DATE: 6-17-87 TESTED BY Jim Clark

Lot B

WITNESS Connie Lyles N/A
QC REP Connie Lyles GOV'T REP

S/N	Frequency of resonance in MHz	R Loss	VSWR
21	19.3	30	1.06
22	19.5	27	1.09
23	19.5	30	1.06
24	19.5	32	1.04
25	19.5	30	1.06
26	19.5	29	1.07
27	19.5	30	1.06
28	19.3	33	1.04
29	19.5	30	1.06
30	19.5	28	1.08
31	19.3	28	1.08
32	19.5	28	1.08
33	19.5	30	1.06
34	19.3	30	1.06
35	19.5	32	1.04
36	19.5	30	1.06
37	19.4	30	1.06
38	19.4	30	1.06
39	19.3	31	1.05
40	19.3	32	1.04
Standard MS 116	17.2	22	1.17

POST HIGH TEMP
PRE HUMIDITY
HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87 TESTED BY: Jim Clark

S/N: B WITNESS: Connie Lyles N/A

QC REP Connie Lyles GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
21	3.1 mA	
22	4.0 mA	
23	3.9 mA	
24	3.6 mA	
25	3.7 mA	
26	4.2 mA	
27	3.5 mA	
28	4.2 mA	
29	3.9 mA	
30	3.3 mA	
31	3.3 mA	
32	2.9 mA	
33	4.3 mA	
34	3.2 mA	
35	3.6 mA	
36	2.7 mA	

Comments:

POST HIGH TEMP
PRE HUMIDITY

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87 TESTED Jim Clark

S/N: B WITNESS: Connie Lyles N/A

QC REP Connie Lyles GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
37	4.2 KV A	
38	3.5 KV A	
39	2.8 KV A	
40	2.8 KV A	

Comments:

IMPEDANCE TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip assembly

DATE: 6-23-87 TESTED BY: Jim Clark

WITNESS: Amy Hudd N/A

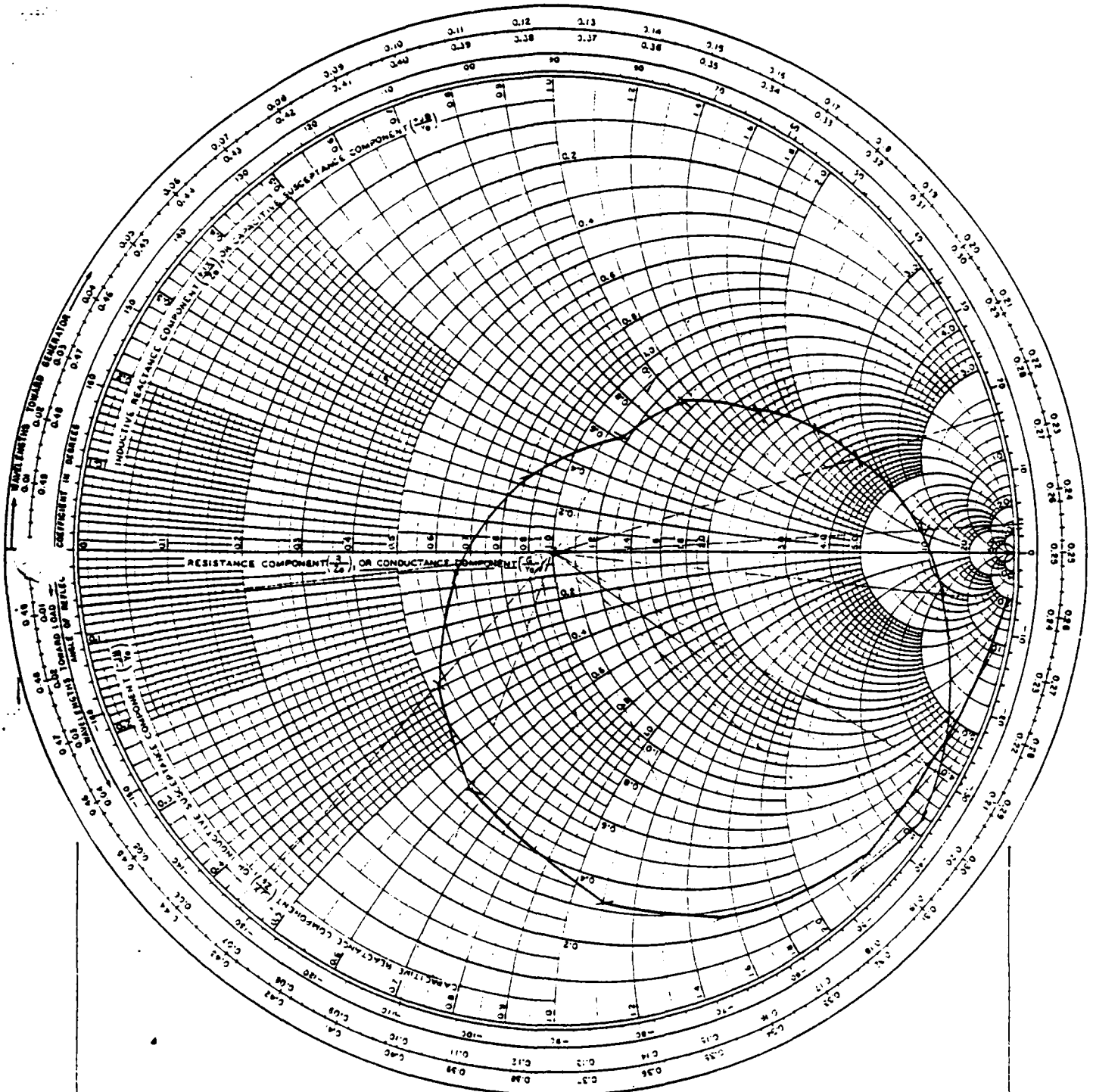
QC REP RAM 4 GOV'T REP

Lot #C

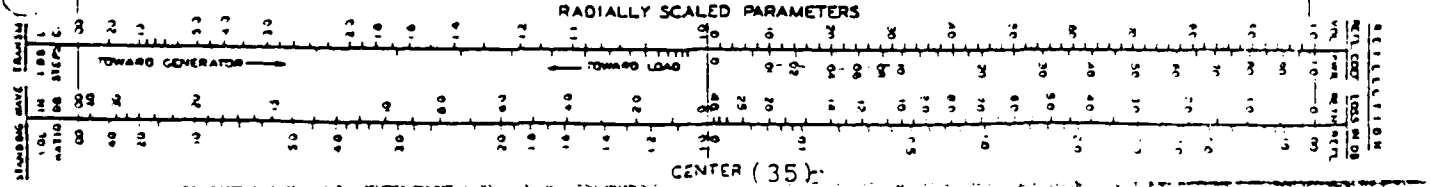
S/N	MS-116				S/N	57			
Freq. (MHz)	|Z|	θ	|Γ|	θ	Freq. (MHz)	|Z|	θ	|Γ|	θ
2.0	953	-89.6	.9993	-6.0	2.0	1.1Kr	-89.6	.9994	-5.2
10.0	161	-88.0	.9804	-34.5	10.0	199.3	-88.78	.9901	-28.16
12.0	116.45	-85.26	.9409	-46.39	12.0	154	-87.50	.9747	-35.95
14.0	77.2	-80.42	.8581	-65.55	14.0	117	-85.92	.9498	-46.2
15.0	57.09	-73.17	.7442	-82.10	15.0	99.21	-84.01	.9199	-5333
16.0	37.75	-54.39	.5311	-109.25	16.0	81.35	-80.92	.8682	-62.86
16.5	31.33	-32.76	.3722	-131.81	16.5	72.10	-78.10	.8225	-69.07
17.0	32.82	-2.85	.2089	-173.1	17.0	62.75	-73.6	.7534	-76.53
17.5	44.83	+17.85	.1665	+109.56	17.5	54.57	-66.17	.6527	-84.50
18.0	60.35	+30.12	.2853	+69.42	18.0	47.21	-56.94	.5430	-94.0
18.5	84.42	+37.60	.4240	+48.17	18.5	41.01	-40.28	.3784	-166.20
19.0	116.60	+40.49	.5360	+34.15	19.0	48.44	+2.2	.0179	-122.71
19.5	158.0	+39.75	.6225	+24.24	19.5	40.76	-18.84	.1949	+105
20.0	216.0	+37.71	.6950	+16.57	20.0	64.34	+18.81	.2075	+51.76
21.0	435.44	+16.4	.8019	+3.17	21.0	141.2	+30.94	.5461	+22.46
22.0	533	-33.7	.8554	-6.0	22.0	305.2	+12.12	.7240	+3.98
26.0	195	-80.60	.9261	-28.48	26.0	199.8	-78.06	.9057	-27.62
30.0	126.50	-84.75	.9392	-43.02	30.0	125.53	-84.53	.9369	-43.31

NAME	TITLE	DWG. NO.
SMITH CHART FORM 756-N		DATE

IMPEDANCE OR ADMITTANCE COORDINATES

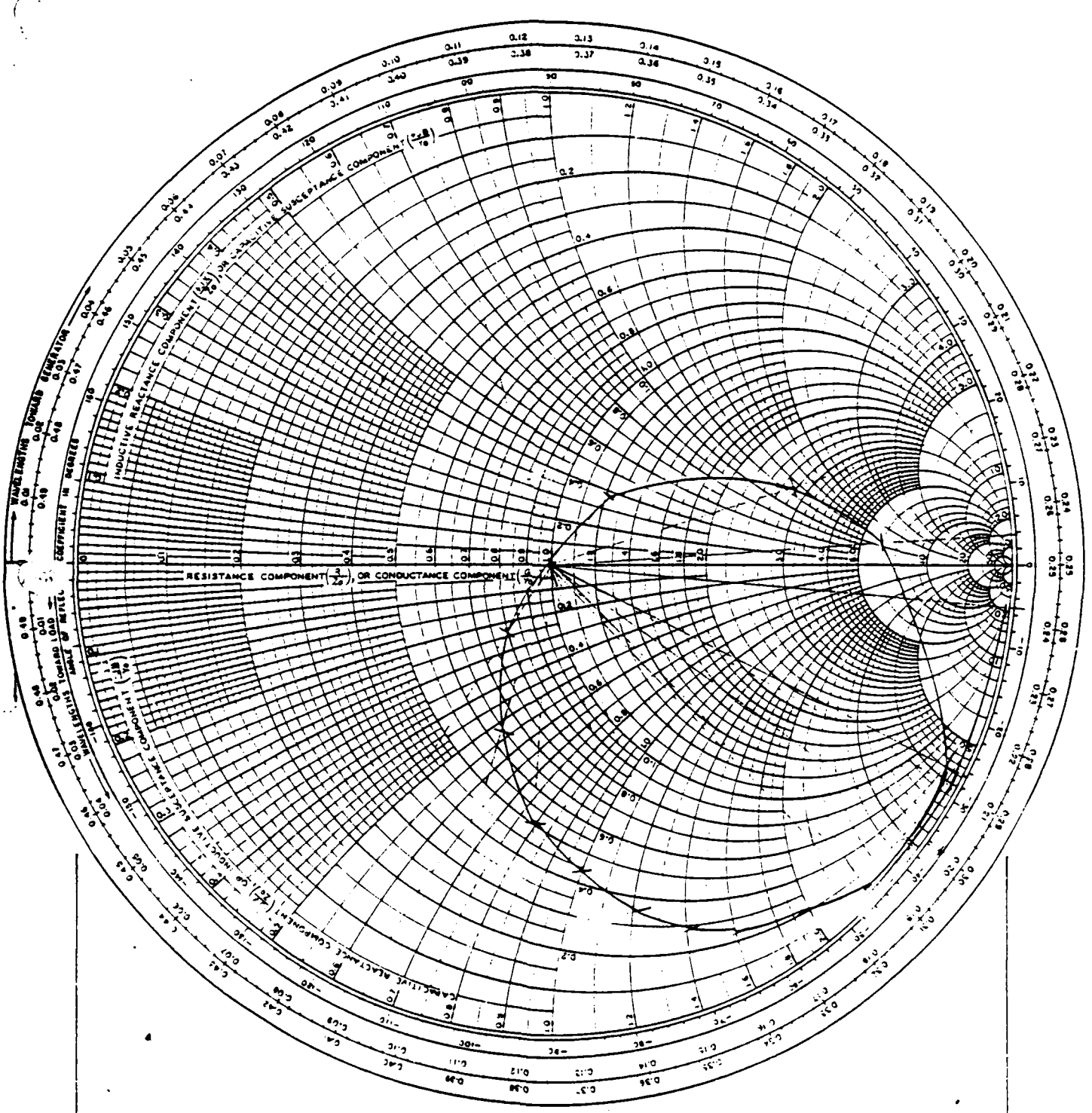


RADIALLY SCALED PARAMETERS



NAME	TITLE	DWG. NO.
SMITH CHART FORM 756-N		DATE

IMPEDANCE OR ADMITTANCE COORDINATES



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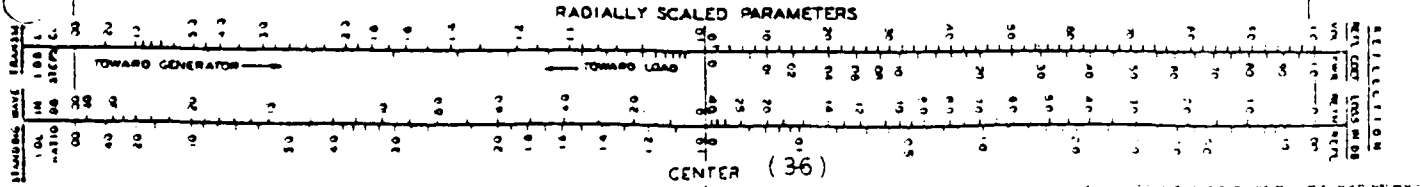


CENTER (36)

POST HIGH TEMP
PRE VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87 TESTED: Jim Clark

S/N: D WITNESS: Connie Lyles N/A

QC REP GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
61	4.8 kV A	
62	3.1 kV A	
63	3.0 kV A	
64	3.0 kV A	
65	4.8 kV A	
66	3.6 kV A	
67	2.9 kV A	
68	3.9 kV A	
69	3.9 kV A	
70	3.1 kV A	
71	4.4 kV A	
72	3.0 kV A	
73	3.7 kV A	
74	3.8 kV A	
75	3.0 kV A	
76	3.4 kV A	

Comments:

POST HIGH TEMP
PRE VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 6-17-87 TESTED: Jim Clark

S/N: D WITNESSED: Connie Lyles N/A

QC REP GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
77	2.8μA	
78	3.0μA	
79	4.9μA	
80	2.9μA	

Comments:

POST HIGH TEMP
PRE VIBRATION

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip

DATE: 6-18-87 TESTED BY Jim Clark

LOT D

WITNESS Connie Lyles N/A
QC REP GOV'T REP

S/N	Frequency of resonance in MHz	R Loss	VSWR
61	19.7	32	1.04
62	19.6	30	1.06
63	19.7	30	1.06
64	19.8	32	1.04
65	19.9	34	1.03
66	19.8	33	1.03
67	19.9	30	1.06
68	19.5	30	1.06
69	19.8	30	1.06
70	19.6	30	1.06
71	19.7	30	1.06
72	19.5	28	1.08
73	20.	33	1.03
74	19.7	30	1.08
75	19.6	30	1.08
76	19.7	32	1.04
77	19.8	32	1.04
78	19.8	32	1.04
79	19.7	32	1.04
80	19.6	30	1.06
Standard MS116	17.3	24	1.13

PRODUCT TESTING LABORATORY TEST LOG

JOB NO. M0019 CUSTOMER _____ P.O. NO. _____

TEST ENGINEER Jim Clark TEST TECH. _____ GSI/WITNESS _____

PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) MS 116 HUPD Serial NO 61-80

TEST DESCRIPTION (Vib., Shock, Etc.) Vibration

TEST PROC. R.A.Miller Test Plan

	DATE	TIME	EVENT DESCRIPTION
Start	6-18-87	10:00	SN 72 At 55hz
Stop	6-18-87	12:00	
Start	6-18-87	14:00	SN 71 At 55hz
Stop	6-18-87	16:00	
Start	6-18-87	16:03	SN 63 At 53.5hz
Stop	6-18-87	17:03	
Start	6-19-87	10:00	SN 63 At 53.5hz
Stop	6-19-87	11:00	
Start	6-19-87	11:10	SN 65 At 52hz
Stop	6-19-87	13:10	
Start	6-19-87	13:15	SN 78 At 53hz
Stop	6-19-87	15:15	
Start	6-19-87	15:18	SN 60 At 52hz
Stop	6-19-87	17:18	
Start	6-22-87	09:55	SN 77 At 56hz
Stop	6-22-87	11:55	
Start	6-22-87	11:55	SN 77 At 56hz
Stop	6-22-87	13:55	
Start	6-22-87	13:57	SN 79 At 52.5hz
Stop	6-22-87	15:57	
Start	6-22-87	15:57	SN 67 At 5..5hz
Stop	6-22-87	16:57	
Start	6-23-87	08:15	SN 67 At 55hz
Stop	6-23-87	09:15	
Start	6-23-87	09:15	SN 80 At 54hz
Stop	6-23-87	11:15	
Start	6-23-87	11:15	SN 70 At 53.5hz
Stop	6-23-87	13:15	
Start	6-23-87	13:15	SN73 At 55hz
Stop	6-23-87	15:15	

1131S-761MS

PAGE _____ OF _____

PRODUCT TESTING LABORATORY TEST LOG

JOB NO. M0019 CUSTOMER _____ P.O. NO. _____

TEST ENGINEER James Dantz TEST TECH. _____ GSI/WITNESS _____

PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) MS 116 HUPD Serial No 61-80 Cont

TEST DESCRIPTION (Vib., Shock, Etc.) Vibration

TEST PROC. R.A. Miller Test Plan

	DATE	TIME	EVENT DESCRIPTION
Start	6-23-87	15:15	SN 64 At 53hz
Stop	6-23-87	17:15	
Start	6-24-87	08:10	SN 68 At 55hz
Stop	6-24-87	10:10	
Start	6-24-87	10:10	SN 61 At 55.5hz
Stop	6-24-87	12:10	
Start	6-24-87	12:10	SN 69 At 54.5hz
Stop	6-24-87	14:10	
Start	6-24-87	14:10	SN 74 At 53hz
Stop	6-24-87	16:10	
Start	6-24-87	16:10	SN 76 At 56hz
Stop	6-24-87	17:00	
Start	6-25-87	08:10	SN 76 At 56hz
Stop	6-25-87	09:20	
Start	6-25-87	09:20	SN 62 At 54hz
Stop	6-25-87	11:20	
Start			
Stop			
Start			
Stop			
Start			
Stop			
Start			
Stop			
Start			
Stop			
Start			
Stop			
Start			
Stop			

1131(9-76)NS

PAGE _____ OF _____

POST VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87 TESTED BY: James Jantz

S/N: D WITNESS: Amy Hudd QC REP Amy Hudd GOV'T REP N/A

UNIT RAM 4 TEST

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
61	4.9 A	
62	3.0 A	
63	3.2 A	
64	3.4 A	
65	4.7 A	
66	3.6 A	
67	3.0 A	
68	3.5 A	
69	3.7 A	
70	3.4 A	
71	4.1 A	
72	2.9 A	
73	3.4 A	
74	3.5 A	
75	3.0 A	
76	3.3 A	

Comments:

POST VIBRATION

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87 TESTED BY: James Jantz James Jantz

S/N: D WITNESS: Amy Hudd Amy Hudd

QC REP GOV'T REP

RAM 4 INJT

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
77	3.0 | | A	
78	3.0 | | A	
79	4.8 | | A	
80	2.8 | | A	

Comments:

POST VIBRATION

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip

DATE: 7-1-87 TESTED BY Ed Eisenheimer

WITNESS Connie Lyles N/A

QC REP GOV'T REP

S/N	Frequency of resonance in MHz	R Loss	VSWR
61	19.8	18	1,28
62	19.7	20	1.22
63	19.8	19	1.25
64	19.5	19	1.24
65	19.9	19	1.24
66	19.9	19	1.24
67	20.	19	1.24
68	19.8	19	1.25
69	19.8	21	1.20
70	19.8	19	1.24
71	19.8	19.5	1.24
72	19.7	18.5	1.27
73	19.8	20	1.22
74	19.8	19	1.25
75	19.9	21	1.18
76	19.9	20	1.22
77	19.9	20	1.22
78	19.9	21	1.20
79	19.8	19	1.25
80	19.7	19	1.25
Standard MS-116	17.3	22	1.04

American Electronic Laboratories, Inc.

June 30, 1987

R.A. Miller Industries, Inc.
P.O. Box 858
Grand Haven, MI 49417

Attention: Mr. Jim Clark Test Report No. 88-236-8205

Reference: R. A. Miller P. O. No. 9646

Gentlemen:

This report certifies the performance of Ballistic Shock testing on twenty (20) 15' Whip Antennas, P/N MS-116 HUPU, S/Nos. 81 thru 100, submitted by R. A. Miller Industries, Inc. The test was conducted in accordance with MIL-S-901, Grade A, Type A, Class 1. Four base mount assemblies and four standard MS-116 Whips (2 MS-116, 1 MS-117, 1 MS-118 per unit) were used repeatedly for the test.

The top section (MS-118) of each antenna was removed and taped 15" lower to the section below it (MS-117) to allow for ceiling clearance.

A visual inspection of the test specimens at the completion of the shock exposure revealed no anomalies due to testing. One base mount assembly was found cracked as a result of testing. All post shock tests are to be performed at R. A. Miller. A copy of the Test Logs and an Equipment List are included in this report.

The test was conducted at the AEL Product Testing Laboratory, Richardson Road, Lansdale, PA 19446. The test specimens were returned to R. A. Miller after completion of testing on June 23, 1987.

Very truly yours,

AMERICAN ELECTRONIC LABORATORIES, INC.

P. M. Spackman

P. M. Spackman, Test Engineer
Product Testing Laboratory

PMS:rb
Enc.

305 Richardson Road, Lansdale, PA 19446, Telephone: 215-822-2929, TWX: 510-661-4976, Cable: AMERLAB

A Subsidiary of AEL Industries, Inc.

EQUIPMENT LIST

EQUIPMENT	MANUFACTURER	MODEL NO.	AEL NO.	CAL DUE DATE
Light Weight High Impact Shock Machine	New England Trawler	MIL-S-901	8944	Each Use

The above equipment has been calibrated by standards which are regularly calibrated and whose accuracies are traceable to the National Bureau of Standards.

Report No. 88-236-8205

Page 1 of 1 page

AMERICAN ELECTRONIC LABORATORIES, Inc.

PRODUCT TESTING LABORATORY TEST LOG

JOB NO. 17525-8205 CUSTOMER R.A. Miller Ind P.O. NO. 9646

TEST ENGINEER DNS TEST TECH. AR GSI/WITNESS

PRODUCT DESCRIPTION (Model No., Type, Ser. No., Quantity, Etc.) 20 - MS-116 HVPU
Section of MS-116 15' whip antenna S/N 81 to 100

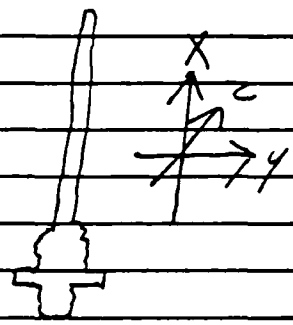
TEST DESCRIPTION (Vib., Shock, Etc.) Shock

TEST PROC. Mil-S-901 Grade A Type A class I

DATE	TIME	EVENT DESCRIPTION
6/23/87		Place fixture on shock machine. Base and other sections on antenna will be used in shock test only MS-116 HVPU will be changed each time.
	1000	Start shock

S/N	X	Y	Z
81	✓	✓	✓
82	✓	✓	✓
83	✓	✓	✓
84	✓	✓	✓
85	✓	✓	✓
86	✓	✓	✓
87	✓	✓	✓
88	✓	✓	✓
89	✓	✓	✓
90	✓	✓	✓
91	✓	✓	✓
92	✓	✓	✓
93	✓	✓	✓
94	✓	✓	✓
95	✓	✓	✓
96	✓	✓	✓
97	✓	✓	✓
98	✓	✓	✓
99	✓	✓	✓
100	✓	✓	✓

Axis



	1500	End of shock Test, on mounting base ~~insulator~~ R insulator has crack in it. No apparent damage done to MS-116 HVPU

113(9-76)NS

POST BALLISTIC SHOCK

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87 TESTED BY: James Jantz

S/N: E WITNESS: Connie Lyles N/A
QC REP GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
81	2.6 KV A	
82	2.6 KV A	
83	2.6 KV A	
84	3.5 KV A	
85	3.9 KV A	
86	4.0 KV A	
87	2.6 KV A	
88	2.6 KV A	
89	2.6 KV A	
90	3.4 KV A	
91	2.7 KV A	
92	4.4 KV A	
93	3.6 KV A	
94	2.6 KV A	
95	2.7 KV A	
96	2.5 KV A	

Comments:

POST BALLISTIC SHOCK

HIGH VOLTAGE STRESS DATA SHEET

MS-116 HVPU

DATE: 7-1-87 TESTED BY: James Jantz
James Jantz

S/N: E WITNESS: Connie Lyles N/A
QC REP Connie Lyles GOV'T REP

ANTENNA S/N	WITHSTOOD DIELECTRIC BREAKDOWN YES	NO
97	2.611A	
98	2.911A	
99	3.511A	
100	4.211A	

Comments:

POST BALLISTIC

VSWR TEST DATA SHEET

MS-116 HVPU Incorporated in the 15 foot whip

DATE: 7-1-87 TESTED BY ED Eisenheimer

WITNESS Connie Lyles N/A

QC REP GOV'T REP

S/N	Frequency of resonance in MHz	R Loss	VSWR
81	21.	20	1.20
82	19.5	20	1.25
83	19.8	24	1.13
84	19.9	21	1.20
85	19.8	20	1.22
86	19.8	20	1.22
87	20.	20	1.22
88	19.9	19	1.25
89	19.9	20	1.21
90	19.7	20	1.22
91	19.9	19	1.25
92	19.8	19	1.24
93	20	22	1.17
94	19.8	19	1.24
95	19.9	21	1.20
96	19.7	22	1.17
97	19.8	21	1.20
98	20.	19	1.25
99	19.8	19	1.24
100	19.9	20	1.22
Standard MS 116	17.3	22	1.04

END

9-87

DTIC